

increasing the global carbon dioxide (CO₂) level, a consequence of global warming. The scarcity and depletion of conventional sources are also cases of concern and have prompted research world-wide into alternative energy sources for internal combustion engines. Biofuels appear to be a potential alternative 'greener' energy substitute for fossil fuels. The problem of using neat vegetable oils in diesel engines relates to their high viscosity. Experiments were designed to study the effect of reducing viscosity by increasing the inlet temperature of vegetable oil fuel on combustion and emission characteristics of diesel engine. The test results showed that the CO production with heated fuel is a little higher than the diesel fuel at higher loading conditions. The CO concentrations in the exhaust were higher for unheated oil operation compared to other fuels. The heated oil showed marginal increase in CO₂ emissions compared to diesel fuel. The hydrocarbon emissions were significantly reduced when running on plant oils. The fuel consumption was a little worse when running on plant fuel. The ignition delay was longer for unheated plant fuel operation.

05/01184 Examination of combustion characteristics and phasing strategies of a natural gas HCCI engine

Soylu, S. *Energy Conversion and Management*, 2005, 46, (1), 101–119. Controlling auto-ignition timing over a wide range of speeds and loads is challenging. Overcoming this challenge in practical HCCI engines requires an improved understanding of the in-cylinder processes and how these processes can be favourably altered by various control techniques. In the current study, a zero-dimensional thermodynamic model that contains a simple heat release sub-model and an auto-ignition model was used in a predictive fashion to better understand the in-cylinder processes and the efficiency potential of a natural gas engine in the HCCI mode. The model was also used for parametric studies to evaluate HCCI control strategies that can be tested on the research engine. The results indicated that if the initial conditions of the mixture are known precisely at intake valve closing, the auto-ignition timing is controllable. A thermal efficiency close to 0.45 is also possible with an IMEP range from 4 to 5 bar for the described engine.

05/01185 Influence of fuel and air/fuel equivalence ratio on the emission of hydrocarbons from a SI engine. 1. Experimental findings

Zervas, E. *et al. Fuel*, 2004, 83, (17–18), 2301–2311.

A spark ignition engine was used to study the impact of fuel composition and of the air/fuel equivalence ratio on exhaust emissions of specific hydrocarbons. The fuel blends used contained eight main hydrocarbons and four oxygenated compounds. The fuel components that produce each exhaust pollutant are identified. The emissions of all HC generally decrease with the addition of oxygenated compounds, except sometimes in the case of methane, ethane and cyclohexane. Under rich conditions, the relative increase of exhaust methane and benzene is more important than the other saturated HC. Some HC are correlated with the physical properties of the fuel and other exhaust pollutants.

05/01186 Influence of fuel and air/fuel equivalence ratio on the emission of hydrocarbons from a SI engine. 2. Formation pathways and modelling of combustion processes

Zervas, E. *et al. Fuel*, 2004, 83, (17–18), 2313–2321.

A spark ignition engine was used to study the impact of fuel composition and of the air/fuel equivalence ratio on exhaust emissions of specific hydrocarbons. The fuel blends used contained eight main hydrocarbons and four oxygenated compounds. The identification of each exhaust pollutant fuel precursor is already done. After this identification, several models correlating the exhaust concentration of these pollutants with the fuel composition are presented on each air/fuel equivalence ratio. Based on the above findings, the main formation paths for the formation of each exhaust pollutant are proposed.

05/01187 Investigation of the temperature oscillations in the cylinder walls of a diesel engine with special reference to the limited cooled case

Rakopoulos, C. D. *et al. International Journal of Energy Research*, 2004, 28, (11), 977–1002.

This work investigates the interesting phenomenon of the temperature (cyclic) oscillations in the combustion chamber walls of a diesel engine. For this purpose, a comprehensive simulation code of the thermodynamic cycle of the engine is developed taking into account both the closed and the open parts of it. The energy and state equations are applied, with appropriate combustion, gas heat transfer, and mass exchange with the atmosphere sub-models, to yield cylinder pressure, local temperatures and heat release histories as well as various performance parameters of the engine. The model is appropriately coupled to a wall periodic conduction model, which uses the gas temperature variation as boundary condition throughout the engine cycle after being treated by Fourier analysis techniques. It is calibrated against measurements, at various load and speed conditions, from an experimental work carried out on a direct injection (DI), naturally

aspirated, four-stroke, diesel engine located at the authors' laboratory, which has been reported in detail previously. After gaining confidence into the predictive capabilities of the model, it is used to investigate the phenomenon further, thus providing insight into many interesting aspects of transient engine heat transfer, as far as the influence that engine wall material properties have on the values of cyclic temperature swings. These swings can take prohibitive values causing high wall thermal fatigue, when materials of specific technological interest such as thermal insulators (ceramics) are used, and may lead to deterioration in engine performance.

05/01188 Investigation on power output of the gamma-configuration low temperature differential Stirling engines

Kongtragool, B. and Wongwises, S. *Renewable Energy*, 2005, 30, (3), 465–476.

This paper provides a study on power output determination of a gamma-configuration, low temperature differential Stirling engine. The former works on the calculation of Stirling engine power output are discussed. Results from this study indicate that the mean pressure power formula is most appropriate for the calculation of a gamma-configuration, low temperature differential Stirling engine power output.

05/01189 Investigation on traveling wave thermoacoustic heat engine with high pressure amplitude

Sun, D. *et al. Energy Conversion and Management*, 2005, 46, (2), 281–291.

As the thermoacoustic conversion process occurring in its regenerator is considered reversible, a travelling wave thermoacoustic engine can theoretically produce and transmit acoustic power with high efficiency. A large-scale multifunction thermoacoustic engine has been designed, constructed and tested. Compared with the results of standing wave thermoacoustic heat engines, the experimental results show the engine has a lower onset temperature, much higher pressure ratio and higher efficiency. With the filling nitrogen of 0.9 MPa, the maximal pressure ratio reached 1.21, and the operation frequency was steady at 25 Hz. The single stage U type orifice pulse tube cooler driven by the engine reached 153.7 K when the working pressure was 1.5 MPa.

05/01190 Manufacturing and testing of a gamma type Stirling engine

Çinar, C. and Karabulut, H. *Renewable Energy*, 2005, 30, (1), 57–66.

In this study, a gamma type Stirling engine with 276 cc swept volume was designed and manufactured. The engine was tested with air and helium by using an electrical furnace as heat source. Working characteristics of the engine were obtained within the range of heat source temperature 700–1000°C and range of charge pressure 1–4.5 bar. Maximum power output was obtained with helium at 1000°C heat source temperature and 4 bar charge pressure as 128.3 W. The maximum torque was obtained as 2 N m at 1000°C heat source temperature and 4 bar helium charge pressure. Results were found to be encouraging to initiate a Stirling engine project for 1 kW power output.

05/01191 Matlab/Simulink-based simulation for digital-control system of marine three-shaft gas-turbine

Yu, Y. *et al. Applied Energy*, 2005, 80, (1), 1–10.

A gas-turbine plant model is required in order to design and develop its control system. In this paper, a simulation model of a marine three-shaft gas-turbine's digital-control system is presented. Acceleration processes are simulated via a Matlab/Simulink program. The effects of some of the main variables on the system's performance are analysed and the optimum values of parameters obtained. A simulation experiment upon a real gas-turbine plant is performed using the digital-control model. The results show that the simulation model is reliable.

05/01192 Non-linear modeling of micro-turbines using NARX structures on the distribution feeder

Jurado, F. *Energy Conversion and Management*, 2005, 46, (3), 385–401.

There is an increasing demand for an accurate model of a micro-turbine to study the transient and long term stability of the overall distribution system, the interconnected network formed by generators, loads and distribution lines. The computational burden required for simulation is highly dependent on the complexity and accuracy of each generator model. The manufacturer often needs to provide the user a reliable low complexity prototype model of the micro-turbine generator set, that is sufficiently accurate for the above application. In this paper, the non-linear autoregressive exogenous (NARX) approach is used to analyse the dynamics of this micro-turbine.